[JP,05-048134,A]

CLAIMS

[Claim(s)]
[Claim 1]A solar cell which is provided with the following and characterized by two or more photoelectric conversion layers on said substrate being connected by electrode.
An insulation or semi insulating substrate.
The 1st conductivity-type semiconductor crystal layer selectively formed on the 1st [of this substrate] field.
A photoelectric conversion layer which consists of the 2nd conductivity-type semiconductor crystal layer selectively formed in a part on a part and the side on this 1st conductivity-type semiconductor crystal layer, and the 1st [of said substrate] field.
An electrode selectively formed in a part of the side and the surface of the 2nd conductivity-type semiconductor crystal layer of another photoelectric conversion layer following a 1st [of said substrate following the surface and the side of the 1st conductivity-type semiconductor crystal layer which this photoelectric conversion layer exposed, and this] field top, and this continuously.

[Claim 2]The 1st conductivity-type semiconductor crystal layer selectively formed on the 1st [of a substrate] field in claim 1, A by-pass diode which consists of the 2nd conductivity-type semiconductor crystal layer selectively formed in a part on a part and the side on this 1st conductivity-type semiconductor crystal layer, and the 1st [of said substrate] field, An electrode selectively formed in a part of the side and the surface of the 2nd conductivity-type semiconductor crystal layer of a photoelectric conversion layer following a 1st [of said substrate following the surface and the side of the 1st conductivity-type semiconductor crystal layer which this by-pass diode exposed, and this] field top, and this continuously, It reaches on the 1st [of said substrate following the surface and the side of the 2nd conductivity-type semiconductor crystal layer of said by-pass diode, and this] field, A solar cell being connected to contrary parallel by electrode selectively formed in a part of the side and the surface of the 1st conductivity-type semiconductor crystal layer which the above following this or another photoelectric conversion layer exposed continuously to one piece or two or more photoelectric conversion layers of said substrate.
[Claim 3]A manufacturing method of a solar cell characterized by comprising the following.
A process which grows up the 1st conductivity-type semiconductor crystal layer on the 1st [of an insulation or semi insulating substrate] field.
A process of etching selectively a part of this 1st conductivity-type semiconductor crystal layer.
A process which grows up the 2nd conductivity-type semiconductor crystal layer on the exposed 1st conductivity-type semiconductor crystal layer and said substrate.
A process which etches selectively a part of 2nd conductivity-type semiconductor crystal layer, is made to crawl on an electrode from the 1st conductivity-type semiconductor crystal layer, a process which makes some substrates expose, and a part of exposed 1st conductivity-type semiconductor crystal layer to a part of 2nd conductivity-type semiconductor crystal layer, and is formed.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the solar cell which used the insulation or semi insulating substrate, and its manufacturing method.
[0002]
[Description of the Prior Art]Drawing 6 is a sectional view showing the structure of the conventional solar cell module currently indicated by "GaAs Interconnect Design and Weld Technology:IEEE PVSC-1985p663." n-GaAs layer 2 and p-GaAs layer 3 by which each solar cell simple substance grew on the 1st [of n-GaAs substrate 1 and said n-GaAs substrate 1] field in the figure, It is formed from the p electrode 4 which contacts said p-GaAs layer 3 electrically, and the n electrode 5 which contacts the 2nd field of said n-GaAs substrate 1 electrically, and the cover glass 7 is stuck on the surface by the 1st adhesives 6. The solar cell of these same types connects the p electrode 4 of the 1st solar cell to the n electrode 5 of the 2nd solar cell by the interconnector 8, Next, one adjacent p electrode 4 of a solar cell and the n electrode 5 of another side are connected one by one, and the solar cell of the predetermined number is connected in series by this as the p electrode 4 of the 2nd solar cell is connected to the n electrode 5 of the 3rd solar cell. And the solar cell module is constituted by carrying out arrangement immobilization of two or more these-connected solar cells on the honeycomb board 10 with the 2nd adhesives 9.
[0003]Next, operation is explained. An electron and a hole pair are generated in p-GaAs layer 3 and n-GaAs layer 2 by the light which entered into the solar cell. The minority carrier in each class of the electron and hole generally generated is called an optical carrier (electron: p-GaAs layer 3, hole:n-GaAs layer 2). The generated optical carrier is diffused within each class, and only what reached the depletion layer formed in the interface of p-GaAs layer 3 and n-GaAs layer 2 before long contributes it to photoelectric current. The generated photoelectric current is outputted outside through the p electrode 4 and the n electrode 5.
[0004]
[Problem(s) to be Solved by the Invention]It will be mostly decided in the area of a photoelectric conversion layer that the value will be a semiconductor material in which the output (voltage, current) of a solar cell simple substance constitutes a photoelectric conversion layer. Therefore, in order to have obtained arbitrary outputs, there was a problem that two or more solar cells had to be connected in series and in parallel. Since especially the output voltage of the solar cell simple substance was restricted by the component of the photoelectric conversion layer, it had to carry out the series connection of many solar cells for obtaining arbitrary voltage.
[0005]The solar cell module of composition of having carried out the series connection of many of the solar cell of the conventional same type, Since the electrode of a p type and a n type is formed in lower both sides, respectively in the top, One p electrode 4 and the n electrode 5 of another side must be connected between the adjacent solar cells, Not only the work which connects between these [with the big level difference for the thickness of a solar cell] two electrodes 4 and 5 by the interconnector 8 is difficult, but there was a problem that the structure of the interconnector 8 also became complicated.
[0006]Since the interval for the interconnector 8 was needed between each solar cells, there was a problem that modular mounting efficiency was restricted.
[0007]An object of this invention is to obtain the solar cell which can obtain arbitrary output voltage, and its manufacturing method, without having been made in order to solve this problem, and connecting two or more solar cells in series by an interconnector.

[0008]
[Means for Solving the Problem]A solar cell concerning this invention uses an insulation or semi insulating thing for a substrate, Form selectively a semiconductor crystal layer used as a photoelectric conversion layer which has pn junction on it, and it is made to crawl on an electrode selectively formed on a p type and an n-type semiconductor crystal layer, respectively to a p type which constitutes another photoelectric conversion layer, and an n-type semiconductor crystal layer, and enables it to connect two or more photoelectric conversion layers on a substrate.
[0009]The 2nd conductivity-type semiconductor crystal layer is selectively formed in a part on the 1st conductivity-type semiconductor crystal layer formed on the 1st [of a substrate] field, its part and side, and the 1st [of a substrate] field, a by-pass diode is constituted, and this is connected to contrary parallel to one piece or two or more photoelectric conversion layers.
[0010]In a stage which grew each semiconductor crystal layer so that an electrode for p type (n type) electric conduction and a n type (p type) semiconductor layer of the photoelectric conversion layer which were formed on a p type (n type) semiconductor layer of this electrode ********** photoelectric conversion layer might insulate. Partial etching is carried out selectively and a level difference is formed, and it has devised so that it may have a process which makes the surface of p type and n type both semiconductor crystal layers expose selectively.
[0011]
[Function]By carrying out the series connection of two or more photoelectric conversion layers on a substrate, it becomes easy to obtain arbitrary output voltage, and modular mounting efficiency of the solar cell in this invention improves. Even if there is a photoelectric conversion layer which the sun does not hit selectively by having a by-pass diode, the full power voltage of the photoelectric conversion layer which the sun has hit is not impressed as reverse voltage. According to the manufacturing method in this invention, connection between two or more photoelectric conversion layers can be made simultaneously.
[0012]
[Example]Hereafter, one example of this invention is described about a figure. Drawing 1 (a) - (e) is a section structure figure showing the manufacturing method and the last structure of a hetero face type GaAs solar cell simple substance where this invention was used. First, n-GaAs layer 2 is grown up by metal-organic chemical vapor deposition (the MOCVD method) on the semi insulating GaAs substrate 11 (drawing 1 (a)), the part is etched selectively, and the field which the semi insulating GaAs substrate 11 surface exposed is formed (drawing 1 (b)). Next, on it, grow up p-GaAs layer 3 by the MOCVD method, and the photoelectric conversion layer 12 is formed, The p-AlGaAs window layer 13 further for the prevention from surface recombination is grown up, and the antireflection film 14 which consists of Si_3N_4 with an optical CVD method is made to deposit on it further (drawing 1 (c)). Next, the antireflection film 14 on the field which etched n-GaAs layer 2 by drawing 1 (b), The p-AlGaAs window layer 13 is etched selectively, p-GaAs layer 3 is made to expose, a part of p-GaAs layer 3 is etched further selectively, and n-GaAs layer 2 and the semi insulating GaAs substrate 11 are made to expose (drawing 1 (d)). The wiring electrode 15 is formed with plating etc. up to the p-GaAs layer 3 surface which was made to crawl on the semi insulating GaAs substrate 11 top, and was exposed from the n-GaAs layer 2 exposed surface at the end (drawing 1 (e)).
[0013]Drawing 2 is a top view showing one example of the solar cell simple substance using the manufacturing method of the hetero face type GaAs solar cell simple substance of drawing 1. As

for n electrode and 11, in drawing 2, n-GaAs layer and 4 are [an antireflection film and 15] wiring electrodes a semi insulating GaAs substrate and 14 p electrode and 5 2.
[0014]By designing arbitrarily the area and the number of the photoelectric conversion layer 12 which have been arranged on the semi insulating GaAs substrate 11, the demanded output (voltage, current) can be supplied with a solar cell simple substance, without constituting a module.
[0015]Since the connection by the wiring electrode 15 between many photoelectric conversion layers 12 is arranged on the same side of the semi insulating GaAs substrate 11 and all the connection can form it simultaneously in the same process, it is easier than connection by the interconnector of many solar cells. The mounting efficiency can also be raised to the level of a wafer process.
[0016]Drawing 3 is a section structure figure showing one example of the solar cell module using the manufacturing method of the hetero face type GaAs solar cell simple substance of drawing 1. In drawing 3, 2 n-GaAs layer and 3 p-GaAs layer and 4 p electrode, 5 -- n electrode and 6 -- the 1st adhesives and 7 -- a cover glass and 8 -- an interconnector and 9 -- as for a photoelectric conversion layer and 13, a honeycomb board and 11 are [an antireflection film and 15] wiring electrodes a p-AlGaAs window layer and 14 a semi insulating GaAs substrate and 12 the 2nd adhesives and 10. As for the n electrode 5 on the one surface of a solar cell, the p electrode 4 on the surface of a solar cell is further connected to the n electrode 5 on the next surface of a solar cell by the interconnector 8 again at the p electrode 4 on the next surface of a solar cell.
[0017]The output (voltage, current) which the solar cell simple substance of this invention supplies receives restriction with the area of the semi insulating GaAs substrate 11. Therefore, to the required power exceeding the restriction, it is necessary to modularize. In such a case, in the solar cell of this invention, since the p electrode 4 and the n electrode 5 are on the same field of the semi insulating GaAs substrate 11, connection between the solar cell simple substances by the interconnector 8 is easier than the conventional solar cell module shown in drawing 6.
[0018]The section structure figure and drawing 5 in which other examples for which drawing 4 used the manufacturing method of the hetero face type GaAs solar cell simple substance of drawing 1 are shown are the top view. in these figures -- 2 -- n-GaAs layer and 3 -- as for a p-AlGaAs window layer and 14, a semi insulating GaAs substrate and 12 are [a wiring electrode and 16] by-pass diodes an antireflection film and 15 a photoelectric conversion layer and 13 p-GaAs layer and 11. n-GaAs layer 2 which the by-pass diode 16 exposed, It is connected to exposed p-GaAs layer 3 which constitutes the photoelectric conversion layer 12 with the wiring electrode 15, p-GaAs layer 3 which the by-pass diode 16 exposed is connected so that it may become contrary parallel to two or more photoelectric conversion layers 12 by which the series connection was carried out to exposed n-GaAs layer 2 which constitutes another photoelectric conversion layer 12 with the wiring electrode 15.
[0019]If some solar cells serve as a shadow when the series connection of many solar cells is carried out and it is operating, the full power voltage from other working solar cells will be impressed to the solar cell used as the shadow as reverse voltage. A solar cell will be destroyed if this reverse voltage exceeds pressure-proofing of a solar cell. Usually, in order to prevent this kind of destruction, a diode is connected to contrary parallel to the solar cell of each or the fixed number. This diode is called the by-pass diode 16.
[0020]In the conventional solar cell, when a module was constituted, the by-pass diode 16 was built into the modular circuit. However, in this invention, the by-pass diode 16 is formed on the

same semi insulating GaAs substrate 11 as the photoelectric conversion layer 12, and is connected to the photoelectric conversion layer 12 by the wiring electrode 15 at contrary parallel. Therefore, circuitry can be made easy when the solar cell simple substance of this invention constitutes a module.
[0021]Although the above-mentioned example showed that by which the by-pass diode 16 was connected to contrary parallel to two or more photoelectric conversion layers 12, it may be connected to contrary parallel to each photoelectric conversion layer 12.
[0022]Although the above-mentioned example showed what used the semi insulating GaAs substrate 11 as a substrate of a solar cell, as long as it is insulation or semi insulating, what consists of other materials, such as sapphire, may be used.
[0023]Although GaAs and AlGaAs were used as a material of the active region of a solar cell in the above-mentioned example, this may also be other materials, such as InP, for example.
[0024]
[Effect of the Invention]As explained above, in a solar cell and a manufacturing method for the same, two or more photoelectric conversion layers consisted of this inventions on insulation or a semi-insulating substrate by introducing selective etching into the production way.
Therefore, it becomes connectable [between the semiconductor crystal layers of the 1st and 2nd conductivity types of an easily different photoelectric conversion layer].
Therefore, two or more photoelectric conversion layers are connected on a substrate, and it is effective in the ability to obtain outputs arbitrary as a solar cell simple substance. Since a by-pass diode can be formed simultaneously, a photoelectric conversion layer is not destroyed by reverse voltage.

TECHNICAL FIELD

[Industrial Application]This invention relates to the solar cell which used the insulation or semi insulating substrate, and its manufacturing method.

PRIOR ART

[Description of the Prior Art]Drawing 6 is a sectional view showing the structure of the conventional solar cell module currently indicated by "GaAs Interconnect Design and Weld Technology:IEEE PVSC-1985p663." n-GaAs layer 2 and p-GaAs layer 3 by which each solar cell simple substance grew on the 1st [of n-GaAs substrate 1 and said n-GaAs substrate 1] field in the figure, It is formed from the p electrode 4 which contacts said p-GaAs layer 3 electrically, and the n electrode 5 which contacts the 2nd field of said n-GaAs substrate 1 electrically, and the cover glass 7 is stuck on the surface by the 1st adhesives 6. The solar cell of these same types connects the p electrode 4 of the 1st solar cell to the n electrode 5 of the 2nd solar cell by the interconnector 8, Next, one adjacent p electrode 4 of a solar cell and the n electrode 5 of another side are connected one by one, and the solar cell of the predetermined number is connected in series by this as the p electrode 4 of the 2nd solar cell is connected to the n electrode 5 of the 3rd solar cell. And the solar cell module is constituted by carrying out arrangement immobilization of two or more these-connected solar cells on the honeycomb board 10 with the 2nd adhesives 9.
[0003]Next, operation is explained. An electron and a hole pair are generated in p-GaAs layer 3 and n-GaAs layer 2 by the light which entered into the solar cell. The minority carrier in each class of the electron and hole generally generated is called an optical carrier (electron: p-GaAs

layer 3, hole:n-GaAs layer 2). The generated optical carrier is diffused within each class, and only what reached the depletion layer formed in the interface of p-GaAs layer 3 and n-GaAs layer 2 before long contributes it to photoelectric current. The generated photoelectric current is outputted outside through the p electrode 4 and the n electrode 5.

EFFECT OF THE INVENTION

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]It will be mostly decided in the area of a photoelectric conversion layer that the value will be a semiconductor material in which the output (voltage, current) of a solar cell simple substance constitutes a photoelectric conversion layer. Therefore, in order to have obtained arbitrary outputs, there was a problem that two or more solar cells had to be connected in series and in parallel. Since especially the output voltage of the solar cell simple substance was restricted by the component of the photoelectric conversion layer, it had to carry out the series connection of many solar cells for obtaining arbitrary voltage.
[0005]The solar cell module of composition of having carried out the series connection of many of the solar cell of the conventional same type, Since the electrode of a p type and a n type is formed in lower both sides, respectively in the top, One p electrode 4 and the n electrode 5 of another side must be connected between the adjacent solar cells, Not only the work which connects between these [with the big level difference for the thickness of a solar cell] two electrodes 4 and 5 by the interconnector 8 is difficult, but there was a problem that the structure of the interconnector 8 also became complicated.
[0006]Since the interval for the interconnector 8 was needed between each solar cells, there was a problem that modular mounting efficiency was restricted.
[0007]An object of this invention is to obtain the solar cell which can obtain arbitrary output voltage, and its manufacturing method, without having been made in order to solve this problem, and connecting two or more solar cells in series by an interconnector.

MEANS

[Means for Solving the Problem]A solar cell concerning this invention uses an insulation or semi insulating thing for a substrate, Form selectively a semiconductor crystal layer used as a photoelectric conversion layer which has pn junction on it, and it is made to crawl on an electrode selectively formed on a p type and an n-type semiconductor crystal layer, respectively to a p type which constitutes another photoelectric conversion layer, and an n-type

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OPERATION

[Function]By carrying out the series connection of two or more photoelectric conversion layers on a substrate, it becomes easy to obtain arbitrary output voltage, and modular mounting efficiency of the solar cell in this invention improves. Even if there is a photoelectric conversion layer which the sun does not hit selectively by having a by-pass diode, the full power voltage of the photoelectric conversion layer which the sun has hit is not impressed as reverse voltage. According to the manufacturing method in this invention, connection between two or more photoelectric conversion layers can be made simultaneously.

EXAMPLE

[Example]Hereafter, one example of this invention is described about a figure. Drawing 1 (a) - (e) is a section structure figure showing the manufacturing method and the last structure of a hetero face type GaAs solar cell simple substance where this invention was used. First, n-GaAs layer 2 is grown up by metal-organic chemical vapor deposition (the MOCVD method) on the semi insulating GaAs substrate 11 (drawing 1 (a)), the part is etched selectively, and the field which the semi insulating GaAs substrate 11 surface exposed is formed (drawing 1 (b)). Next, on it, grow up p-GaAs layer 3 by the MOCVD method, and the photoelectric conversion layer 12 is formed, The p-AlGaAs window layer 13 further for the prevention from surface recombination is grown up, and the antireflection film 14 which consists of Si_3N_4 with an optical CVD method is made to deposit on it further (drawing 1 (c)). Next, the antireflection film 14 on the field which etched n-GaAs layer 2 by drawing 1 (b), The p-AlGaAs window layer 13 is etched selectively, p-GaAs layer 3 is made to expose, a part of p-GaAs layer 3 is etched further selectively, and n-GaAs layer 2 and the semi insulating GaAs substrate 11 are made to expose (drawing 1 (d)). The wiring electrode 15 is formed with plating etc. up to the p-GaAs layer 3 surface which was made to crawl on the semi insulating GaAs substrate 11 top, and was exposed from the n-GaAs layer 2 exposed surface at the end (drawing 1 (e)).
[0013]Drawing 2 is a top view showing one example of the solar cell simple substance using the manufacturing method of the hetero face type GaAs solar cell simple substance of drawing 1. As for n electrode and 11, in drawing 2, n-GaAs layer and 4 are [an antireflection film and 15] wiring electrodes a semi insulating GaAs substrate and 14 p electrode and 5 2.

[0014]By designing arbitrarily the area and the number of the photoelectric conversion layer 12 which have been arranged on the semi insulating GaAs substrate 11, the demanded output (voltage, current) can be supplied with a solar cell simple substance, without constituting a module.
[0015]Since the connection by the wiring electrode 15 between many photoelectric conversion layers 12 is arranged on the same side of the semi insulating GaAs substrate 11 and all the connection can form it simultaneously in the same process, it is easier than connection by the interconnector of many solar cells. The mounting efficiency can also be raised to the level of a wafer process.
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[0017]The output (voltage, current) which the solar cell simple substance of this invention supplies receives restriction with the area of the semi insulating GaAs substrate 11. Therefore, to the required power exceeding the restriction, it is necessary to modularize. In such a case, in the solar cell of this invention, since the p electrode 4 and the n electrode 5 are on the same field of the semi insulating GaAs substrate 11, connection between the solar cell simple substances by the interconnector 8 is easier than the conventional solar cell module shown in drawing 6.
[0018]The section structure figure and drawing 5 in which other examples for which drawing 4 used the manufacturing method of the hetero face type GaAs solar cell simple substance of drawing 1 are shown are the top view. in these figures -- 2 -- n-GaAs layer and 3 -- as for a p-AlGaAs window layer and 14, a semi insulating GaAs substrate and 12 are [a wiring electrode and 16] by-pass diodes an antireflection film and 15 a photoelectric conversion layer and 13 p-GaAs layer and 11. n-GaAs layer 2 which the by-pass diode 16 exposed, It is connected to exposed p-GaAs layer 3 which constitutes the photoelectric conversion layer 12 with the wiring electrode 15, p-GaAs layer 3 which the by-pass diode 16 exposed is connected so that it may become contrary parallel to two or more photoelectric conversion layers 12 by which the series connection was carried out to exposed n-GaAs layer 2 which constitutes another photoelectric conversion layer 12 with the wiring electrode 15.
[0019]If some solar cells serve as a shadow when the series connection of many solar cells is carried out and it is operating, the full power voltage from other working solar cells will be impressed to the solar cell used as the shadow as reverse voltage. A solar cell will be destroyed if this reverse voltage exceeds pressure-proofing of a solar cell. Usually, in order to prevent this kind of destruction, a diode is connected to contrary parallel to the solar cell of each or the fixed number. This diode is called the by-pass diode 16.
[0020]In the conventional solar cell, when a module was constituted, the by-pass diode 16 was built into the modular circuit. However, in this invention, the by-pass diode 16 is formed on the same semi insulating GaAs substrate 11 as the photoelectric conversion layer 12, and is connected to the photoelectric conversion layer 12 by the wiring electrode 15 at contrary parallel.

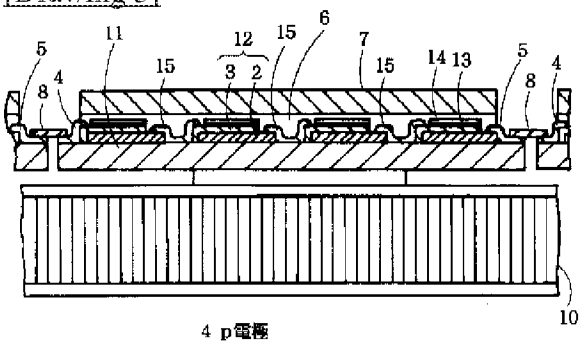
Therefore, circuitry can be made easy when the solar cell simple substance of this invention constitutes a module.
[0021]Although the above-mentioned example showed that by which the by-pass diode 16 was connected to contrary parallel to two or more photoelectric conversion layers 12, it may be connected to contrary parallel to each photoelectric conversion layer 12.
[0022]Although the above-mentioned example showed what used the semi insulating GaAs substrate 11 as a substrate of a solar cell, as long as it is insulation or semi insulating, what consists of other materials, such as sapphire, may be used.
[0023]Although GaAs and AlGaAs were used as a material of the active region of a solar cell in the above-mentioned example, this may also be other materials, such as InP, for example.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a section structure figure showing the manufacturing method and the last structure of a hetero face type GaAs solar cell simple substance by one example of this invention.
[Drawing 2]It is a top view showing the solar cell simple substance by one example of this invention.
[Drawing 3]It is a section structure figure showing the solar cell module by one example of this invention.
[Drawing 4]It is a section structure figure showing the hetero face type GaAs solar cell simple substance by other examples of this invention.
[Drawing 5]It is a top view showing the solar cell simple substance by other examples of this invention.
[Drawing 6]It is a section structure figure showing the conventional solar cell module.
[Description of Notations]
2 n-GaAs layer
3 p-GaAs layer
4 p electrode
5 n electrode
8 Interconnector
10 Honeycomb board
11 Semi insulating GaAs substrate
12 Photoelectric conversion layer
13 p-AlGaAs window layer
14 Antireflection film
15 Wiring electrode
16 By-pass diode

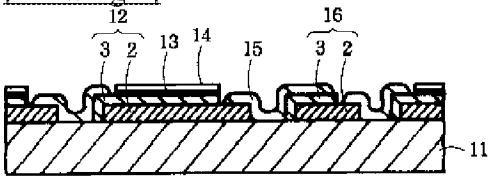
DRAWINGS

[Drawing 3]



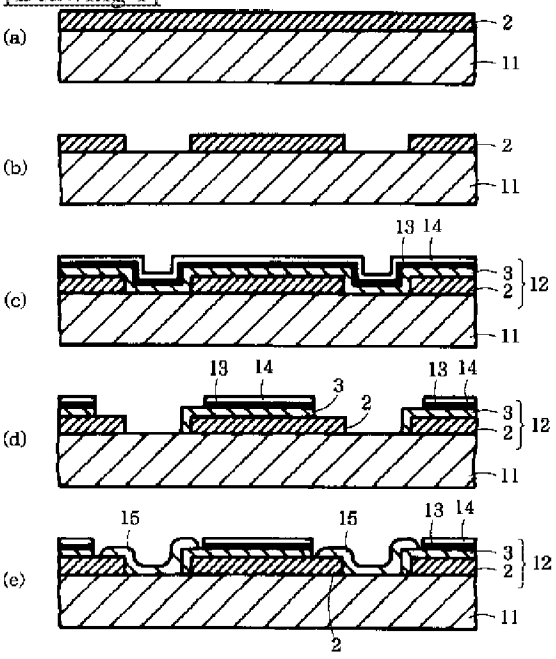
4 p電極
5 n電極
8 インタコネクタ
10 ハニカムボード

[Drawing 4]



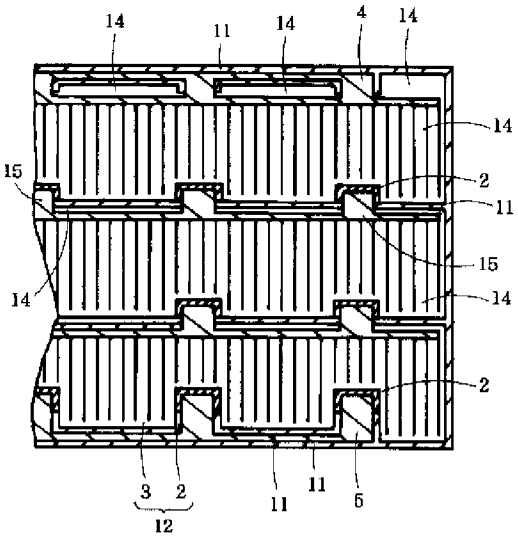
16 バイパスダイオード

[Drawing 1]



2 n－GaAs層
3 p－GaAs層
11 半絶縁性GaAs基板
12 光電変換層
13 p－AlGaAs窓層
14 反射防止膜
15 配線電極

[Drawing 2]



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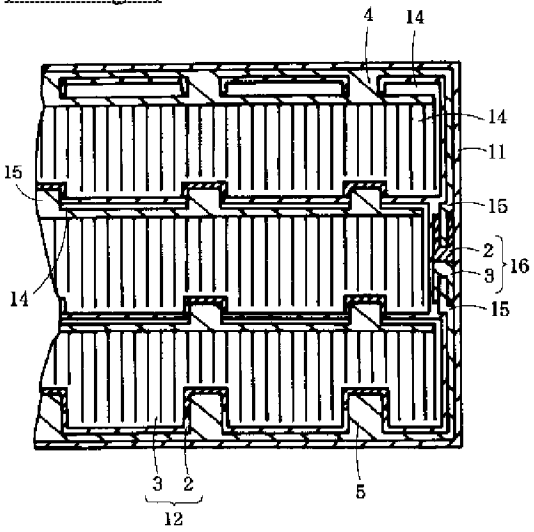
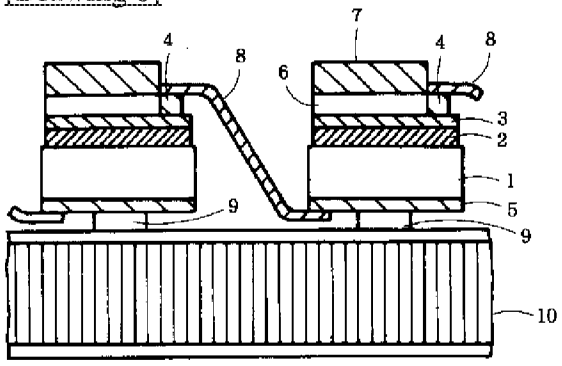


[Drawing 6]



WRITTEN AMENDMENT

---------- [Written amendment]
[Filing date]May 12, Heisei 4
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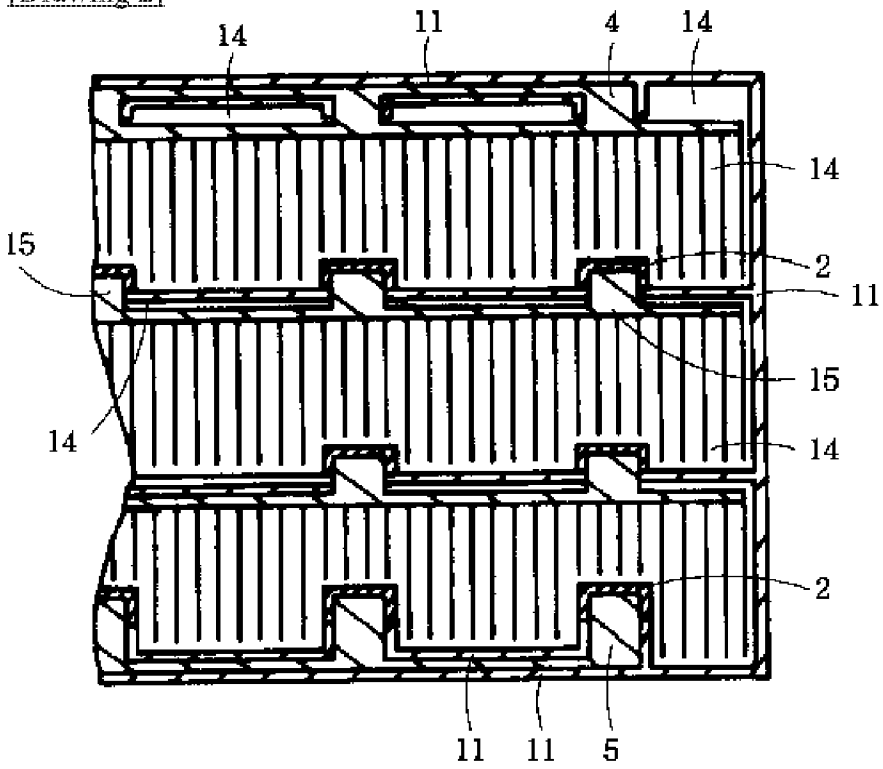
[Item(s) to be Amended]Drawing 2
[Method of Amendment]Change
[Proposed Amendment]
[Drawing 2]



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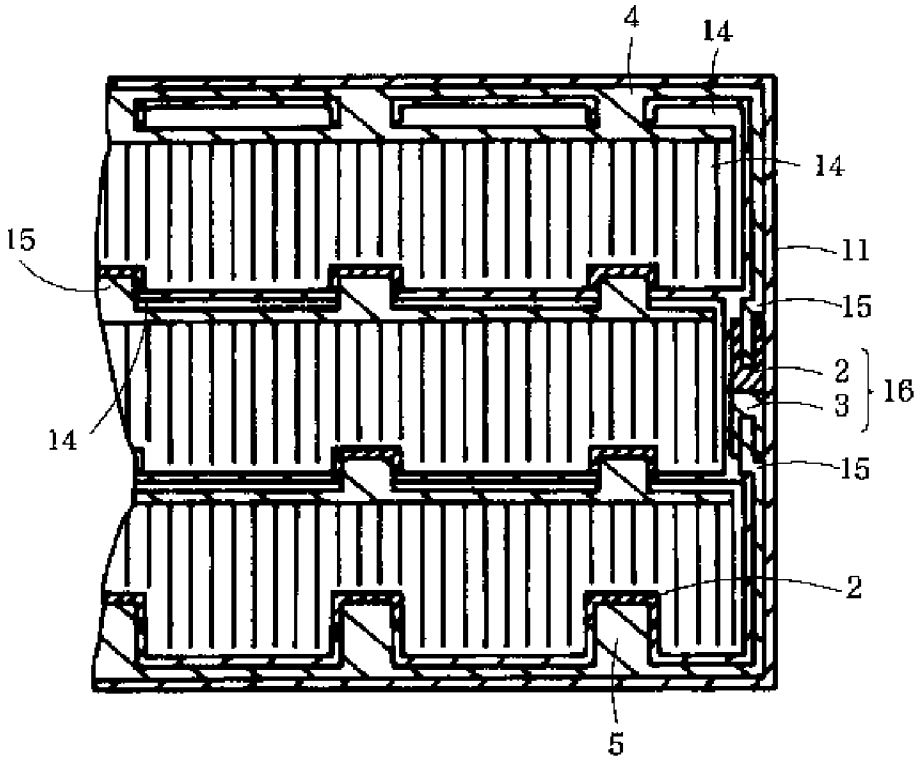
[Drawing 5]


4
14
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